INTERNAL CONTROL LEAK INTEGRATED IN A DRIVER FRAME

FIELD

[0001] An embodiment of the invention is directed to internal control leaks, vents, ports or the like integrated in a driver frame. Other embodiments are also described and claimed.

BACKGROUND

[0002] Whether listening to an MP3 player while traveling, or to a high-fidelity stereo system at home, consumers are increasingly choosing intra-canal and intra-concha earphones for their listening pleasure. Both types of electro-acoustic transducer devices have a relatively low profile housing that contains a receiver or driver (an earpiece speaker). The low profile housing provides convenience for the wearer, while also providing very good sound quality.

SUMMARY

[0003] Drivers are commonly used in mobile applications such as earphones for sound output. The driver is positioned within an interior chamber formed by the earphone housing. The driver itself may include a driver frame that supports the driver components, for example, the diaphragm and forms a front volume chamber and a back volume chamber around the diaphragm. The driver front volume chamber may be coupled to an acoustic output opening of the earphone housing to output sound generated by the diaphragm to the user's ear. In some cases, where the earphone fits relatively tightly within the ear and forms a seal with the ear canal, or at least a partial seal, user's may experience an undesirable occlusion effect. To address this, aspects disclosed herein may include a number of passive leaks or vents formed within the driver frame to couple the chambers therein to one another to improve sound output (e.g., reduce occlusion effect). Representatively, the frame may include an internal control leak integrated in the frame (e.g., formed through the frame portion that supports the diaphragm) that connects the back volume to the front volume. The internal control leak may include two control leaks arranged around the driver. The internal control leaks may, in some aspects, allow for pressure equalization. In still further aspects, the frame may include a driver vent that couples the back side of the diaphragm to the back volume chamber. The driver vent may be used for low frequency tuning and/or to enlarge the size of the back volume. In some cases, the driver vent may include two elongated driver vents that are balanced or symmetrically arranged around the frame. For example, the drive vents may be arranged along opposite sides of the diaphragm and have centroids that are aligned with a center of the diaphragm. In addition, the assembly may include an external control leak that couples the front volume chamber to an ambient environment and/or a rear vent that couples the back volume chamber to the ambient environment. In some cases, the rear vent may couple the back volume chamber to another larger chamber within the enclosure to further enlarge the back volume chamber. In some cases, an acoustic mesh may be coupled to the driver vent and the internal control leak. The acoustic mesh may be insert molded in the driver frame and tuned, in conjunction with the driver vents, to a specific acoustic resistance to optimize high frequency response and acoustic damping. In some cases, the shape and/or size of the vents and/or internal control leak may be optimized to minimize a rocking of the diaphragm, asymmetric acoustic loading and/or allow airflow restrictions.

[0004] Representatively, in one aspect a driver assembly includes a driver module, an internal control leak and first and second driver vents. The drive module may have a driver frame and a diaphragm coupled to the driver frame, the driver frame defining a front volume chamber coupled to a first side of the diaphragm and a back volume chamber. The internal control leak may be formed through the driver frame to couple the front volume chamber to the back volume chamber. The first driver vent and the second driver vent may be formed through the driver frame to couple a second side of the diaphragm to the back volume chamber, and a centroid of the first driver vent is aligned with a centroid of the second driver vent. In some aspects, the internal control leak, the first driver vent and the second driver vent are formed through a same wall of the driver frame that the diaphragm is coupled to. In still further aspects, the internal control leak is a first internal control leak, and the assembly further includes a second internal control leak. The first internal control leak and the second internal control leak may be radially outward to the first driver vent and the second driver vent. In some aspects, the first driver vent and the second driver vent may have a same shape. In some cases, a shape of at least one of the first driver vent and the second driver vent may be asymmetrical. Still further, the centroid of the first driver vent and the centroid of the second driver vent may be aligned with a center of the diaphragm. In some aspects, the assembly may further include a single piece of acoustic mesh acoustically coupled to the internal control leak and one of the first acoustic vent or the second acoustic vent. In addition, the assembly may include an enclosure wall that forms an interior chamber and an acoustic outlet port to an ambient environment, wherein the driver module is positioned within the interior chamber and the acoustic outlet port couples the front volume chamber to the ambient environment.

[0005] In another aspect, a driver assembly includes an enclosure having an enclosure wall that forms an interior chamber and an acoustic outlet port coupling the interior chamber to an ambient environment. The assembly further includes a driver module positioned within the interior chamber, the driver module having a driver frame to which a diaphragm and a magnet assembly are coupled, the driver frame dividing the interior chamber into a front volume chamber coupled to a first side of the diaphragm and a back volume chamber. The assembly also includes an internal control leak formed through the driver frame to couple the front volume chamber to the back volume chamber, a first driver vent and a second driver vent formed through the driver frame to couple a second side of the diaphragm that faces the magnet assembly to the back volume chamber, and a rear vent formed through the enclosure to couple the back volume chamber to the ambient environment. The internal control leak may be positioned through a portion of the driver frame that is radially outward to a portion of the driver frame the diaphragm is coupled to. The first driver vent and the second driver vent may be positioned through a portion of the driver frame that is radially inward to a portion of the driver frame the diaphragm is coupled to. In some cases, a centroid of the first driver vent and a centroid of the second driver vent are arranged at diametrically opposed locations